TANJONG KATONG SECONDARY SCHOOL
Preliminary Examination 2022
Secondary 4

CANDIDATE NAME

CLASS

INDEX NUMBER

MATHEMATICS   **4048/02**

Paper 2   **Monday 22 Aug 2022**

2 hours and 30 minutes

READ THESE INSTRUCTIONS FIRST

Write your name, class and register number on all the work you hand in.
Write in dark blue or black pen.
You may use a HB pencil for any diagrams or graphs.
Do not use staples, paper clips, highlighters, glue or correction fluid/ tape.

Answer **all** questions.
If working is needed for any question it must be shown with the answer.
Omission of essential working will result in loss of marks.
You are expected to use a scientific calculator to evaluate explicit numerical expressions.
If the degree of accuracy is not specified in the question, and if the answer is not exact, give the answer to three significant figures. Give answers in degrees to one decimal place.
For π, use either your calculator value or 3.142, unless the question requires the answer in terms of π.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.
The total of the marks for this paper is 100.

Mathematical Formulae

Compound Interest

$$\text{Total Amount} = P\left(1 + \frac{r}{100}\right)^n$$

Mensuration

$$\text{Curved surface area of a cone} = \pi r l$$

$$\text{Curved surface area of a sphere} = 4\pi r^2$$

$$\text{Volume of a cone} = \frac{1}{3}\pi r^2 h$$

$$\text{Volume of a sphere} = \frac{4}{3}\pi r^3$$

$$\text{Area of triangle } ABC = \frac{1}{2}ab\sin C$$

$$\text{Arc length} = r\theta, \text{ where } \theta \text{ is in radians}$$

$$\text{Sector area} = \frac{1}{2}r^2\theta, \text{ where } \theta \text{ is in radians}$$

Trigonometry

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

$$a^2 = b^2 + c^2 - 2bc\cos A$$

Statistics

$$\text{Mean} = \frac{\sum fx}{\sum f}$$

$$\text{Standard Deviation} = \sqrt{\frac{\sum fx^2}{\sum f} - \left(\frac{\sum fx}{\sum f}\right)^2}$$

[Turn over for Question 1]

[Turn over

Answer all questions.

1 **(a)** Solve the inequality $\dfrac{y+6}{5} > \dfrac{2y-1}{8}$.

Answer …………….………….. [2]

(b) Solve these simultaneous equations.

$$3x - 7y = -41$$

$$4y + 5x = 10$$

Answer $x =$ …………….………

$y =$ ………..………….. [3]

(c) Express as a single fraction in its simplest form $\dfrac{2}{(x-2)^2}+\dfrac{x+3}{2-x}$.

Answer ……………..………….. [2]

(d) Simplify $\dfrac{(2a^3)^2}{27bc}\div\dfrac{a}{9b^2c^3}$.

Answer ……………..………….. [2]

(e) Simplify $\dfrac{y^2+3y-10}{3y^2+30y+75}$.

Answer …………..………...…….[3]

[Turn over

2 Deli Burgers sells fish burgers, chicken burgers and beef burgers at Outlets A and B.

The table below shows the average number of burgers sold in both outlets on a weekday.

	Fish burger	**Chicken burger**	**Beef burger**
Outlet A	250	280	260
Outlet B	320	300	290

(a) Represent the information in the table above in a 2×3 matrix **R**.

Answer $\mathbf{R} = \left(\begin{array}{ccc} & & \end{array} \right)$ [1]

(b) (i) Evaluate $\mathbf{V} = \mathbf{R} \begin{pmatrix} 1 \\ 1 \\ 1 \end{pmatrix}$.

Answer $\mathbf{V} = $ [1]

(ii) State what each element in **V** represents.

Answer…………………………………………………………………………………

………………………………………………………………………………………………

………………………………………………………………………………………………

………………………………………………………………………………………..………[1]

(c) On average, Outlets A and B expect to sell 20% more fish burgers, 15% more chicken burgers, and 30% more beef burgers per day over the weekend.

  (i) Write down a 3×1 column matrix **E**, such that **RE** will give the expected average number of burgers to be sold in the Outlets A and B on a particular day during the weekend.

Answer **E** =   [1]

  (ii) Evaluate the matrix **Q** = **RE**.

Answer **Q** =   [1]

  (iii) Hence, represent the total number of burgers sold at each outlet in a week in a 2×1 column matrix **T**.

Answer **T** =   [1]

(d) Outlets A and B sell each burger at $3.50.
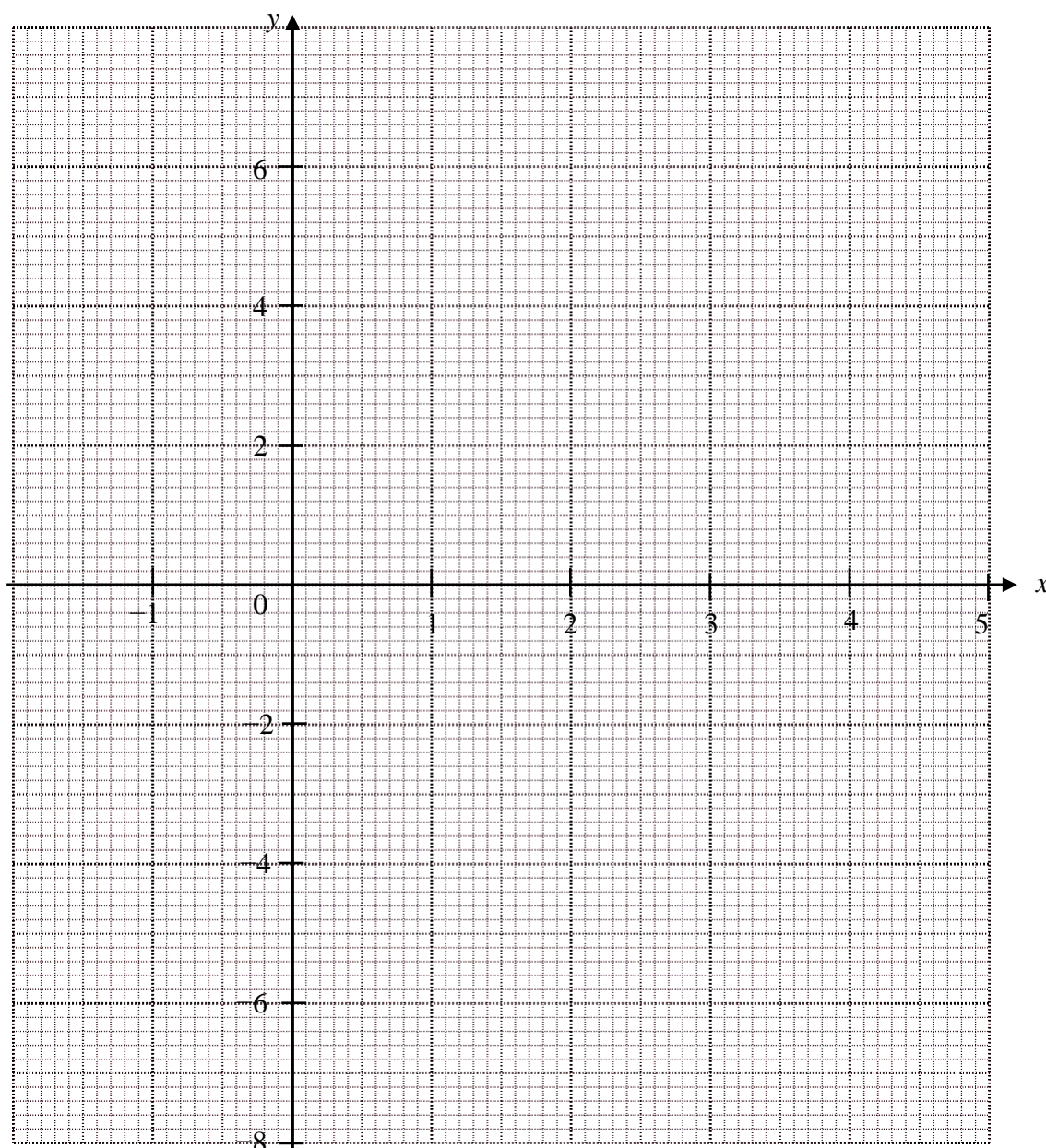Find the total sales for Deli Burgers in a week.

Answer $ …………....…….[2]

[Turn over

3 **(a)** Complete the table of values for $y = \frac{1}{5}(18x - x^3)$.

x	-1	0	1	2	3	4	5
y	-3.4	0	3.4	5.6	5.4	1.6	

[1]

(b) On the grid, draw the graph of $y = \frac{1}{5}(18x - x^3)$ for $-1 \le x \le 5$.

[3]

(c) Use your graph to find the values of x for which $15 = 18x - x^3$
in the range $-1 \le x \le 5$.

Answer $x =$ …………… or …………….. [3]

(d) The line $y = kx + 5$ where k is a constant, is a tangent to the curve. By drawing a suitable straight line on the graph, find the value of k.
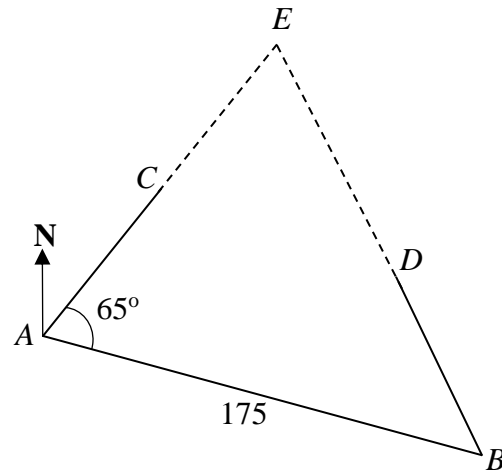
Answer $k =$ ………………………….. [2]

(e) Explain why the equation $\frac{1}{5}(18x - x^3) = p$ does not have solutions for some values of p in the range $-1 \le x \le 5$.

Answer ..……………...……….……………...………...………………..……

……..…………….……………..………...…………….…………………..…...[1]

(f) The solutions of the equation $x^3 + Ax + B = 0$ are obtained from the x-coordinates of the points at which the line $y = 2 - x$ intersects with the graph $y = \frac{1}{5}(18x - x^3)$. Find the value of A and the value of B.

Answer $A =$………..… and $B =$…………..… [3]

[Turn over

4

In the diagram, *A*, *B*, *C*, *D* and *E* are on level ground. Ann and Tony start jogging at the same time from *A* and from *B* respectively.

Ann jogs in the direction *AC* at an average speed of 1.5m/s.

Tony jogs in the direction *BD*. Ann and Tony meet after 1.5 minutes at *E*.

The bearing of *C* from *A* is 040°. Angle *CAB* = 65° and *AB* = 175 m.

(a) **(i)** Calculate *AE*.

Answer …………..…………. m [1]

(ii) Calculate *BE*.

Answer …………..…………. m [2]

(b) Calculate the bearing of *E* from *B*.
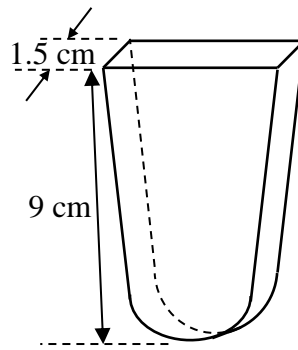
Answer ………….…………. [4]

(c) A 3-metre flagpole stands vertically at *D*.
The greatest possible angle of elevation of the top of the pole from a point *F* along *AB* is 4°.

Calculate *FD*.

Answer …………..……. m [2]

[Turn over

5 An ice-cream mould is in the shape of the prism shown below.

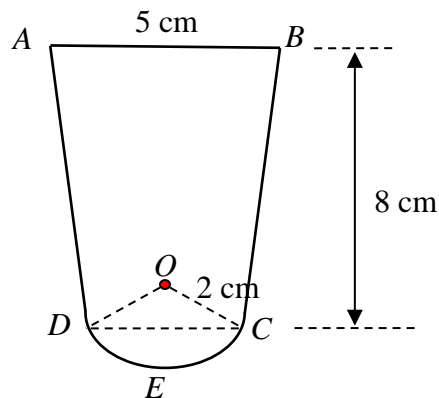The thickness of the mould is 1.5 cm and it has a height of 9 cm.

The cross-section of the ice-cream mould consists of a trapezium *ABCD* and a segment *CED* as shown below.

In the trapezium, *AB* = 5 cm, the perpendicular distance between *AB* and *DC* is 8 cm.

Segment *CED* is part of a circle with radius 2 cm and centre *O*.

(a) Show that $\angle COD = \dfrac{2}{3}\pi$.

Answer
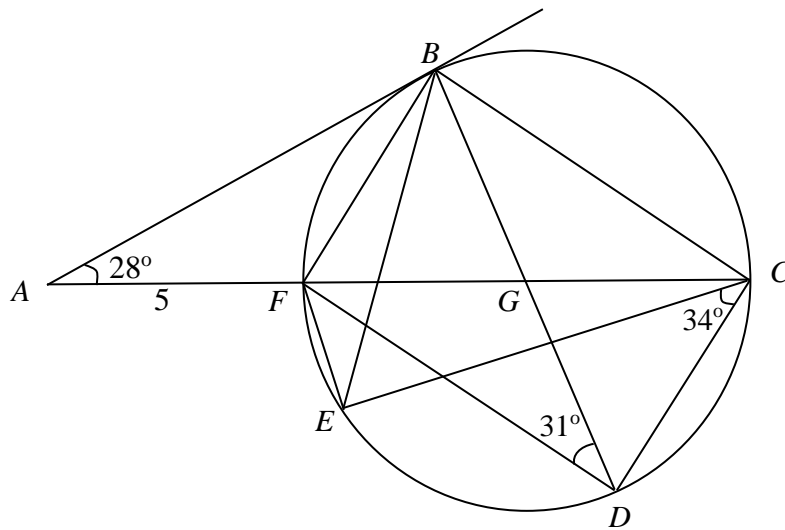
[2]

(b) Calculate the area of segment *CDE*.

Answer ……………..……. cm^2 [3]

(c) Calculate the volume of the ice-cream mould.

Answer …………..……. cm^3 [4]

[Turn over

6

In the diagram, *B, C, D, E* and *F* lie on the circle.

AB is a tangent to the circle at *B* where *BD* is the diameter. *AFC* is a straight line.

$AF = 5$ cm. $\angle DCE = 34^\circ$, $\angle BDF = 31^\circ$ and $\angle BAC = 28^\circ$.

(a) Show that *G* is the centre of the circle.

Answer ……..………………………………………………………………………

……………………………………………………………………………………..

………………………………………………………………………………………[2]

(b) Name a triangle that is congruent to triangle *FGD*.

Show that they are congruent and give a reason for each statement you make.

Answer ……..………………………………………………………………………

……………………………………………………………………………………..

………………………………………14……………………………………………..

………………………………………………………………………………………[3]

(c) Calculate the length of *GB*.

Answer …………..…. cm [3]

(d) Giving a reason for each step of your working, find

(i) $\angle EBD$,

Answer …………..…. [1]

(ii) $\angle BFE$.

Answer …………..…. [2]

[Turn over

7 In the diagram, *PQRS* is a parallelogram. The diagonals *PR* and *QS* intersect at *T*.
V is a point on *QT*. *U* is a point on *QR* such that $QR = 3QU$.
V is the midpoint of *QT*. $\overrightarrow{QU} = \mathbf{a}$ and $\overrightarrow{RT} = \mathbf{b}.$
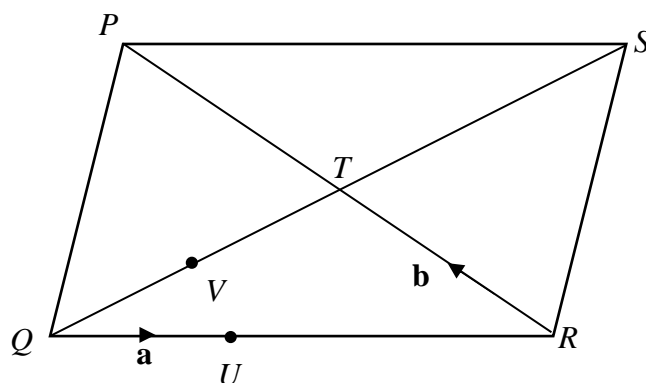
(a) Express, as simply as possible, in terms of **a** and/or **b**,

(i) $\overrightarrow{QT}$,

Answer $\overrightarrow{QT}$ = ……………………….[1]

(ii) $\overrightarrow{QP}$,

Answer $\overrightarrow{QP}$ ……………………. [1]

(iii) $\overrightarrow{VU}$.

Answer $\overrightarrow{VU}$ = …………………... [1]

(b) Prove that points *P, V* and *U* are collinear.

Answer

[3]

(c) Calculate the value of

(i) $\dfrac{\text{Area of } \Delta PQU}{\text{Area of } \Delta PQR}$,

Answer ………………………. [1]

(ii) $\dfrac{\text{Area of } \Delta PQV}{\text{Area of } PQRS}$.

Answer ………………………. [2]

[Turn over

8 A bag contains 15 balls, n of which are white and the rest are yellow.
Jane picks two balls from the bag, at random, without replacement.

(a) Complete the tree diagram.

First ball   Second ball

…..........   White

White

….........

…..........   Yellow

….........

…..........   White

….........

Yellow

….........

…..........   Yellow

….........
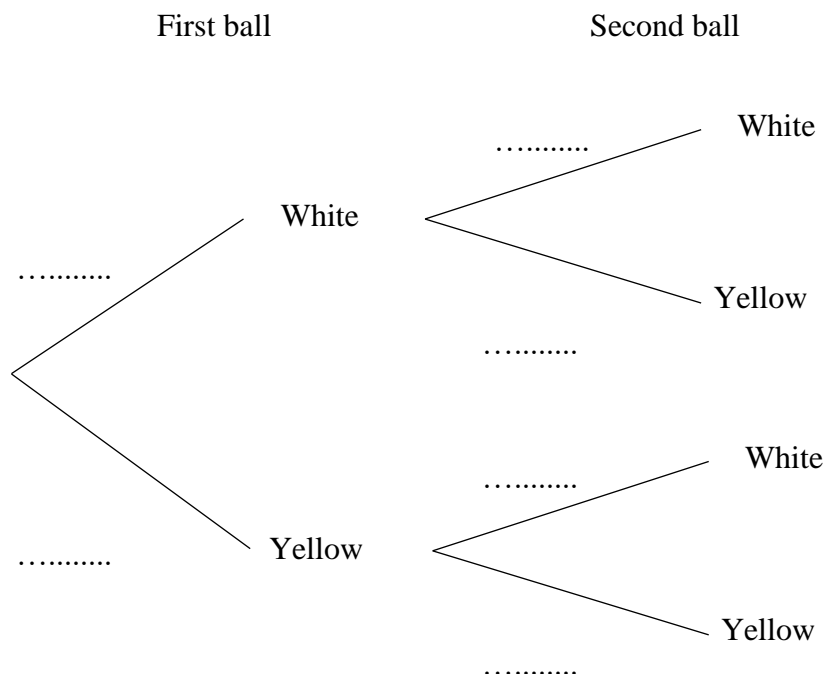
[2]

(b) The probability that Jane picks two yellow balls is $\dfrac{2}{35}$.

Write down an equation to represent this information and show that it simplifies to

$$n^2 - 29n + 198 = 0.$$

Answer

[3]

(c) (i) Solve the equation $n^2 - 29n + 198 = 0$.

Answer n = ……… or ………… [3]

(ii) Explain why one of the solutions in part **(c)(i)** must be rejected.

Answer ……..……………………………………………………………….

..……………………………………………………………………………… [1]

(d) Hence, find as a fraction in its simplest form, the probability that Jane picks a white and yellow ball.

Answer…………….………. [2]

[Turn over

9 The marks of ten tests for two students Ramli and May are recorded below.

Ramli   77, 70, 59, 67, 66, 77, 88, 47, 74, 85

May   77, 73, 69, 85, 68, 74, 78, 45, 76, 77

(a) Complete the table.

	Mean	**Median**	**Interquartile Range**	**Standard Deviation**
Ramli	71			11.5
May	72.2	75	8	10.1

[2]

(b) Make two comparisons on the test performance of Ramli and May.

Answer

1. ....

....

2. ....

.... [2]

(c) The passing mark of the tests is 50 and the marks obtained in the tests is an integer. Ramli is given another chance to take the test that he failed. He wants to achieve a higher mean mark than May. Given that May's mean mark stays constant, what is the minimum marks he must obtain in the test?

Answer………………………. [2]

(d) There was a glitch in the system for processing results.
The results should all decrease by 2 marks.

State how the mean marks and standard deviation of the marks will be affected by this error.

Answer

1. Effect on the mean marks:

   ....

   ....

2. Effect on the standard deviation of the marks:

   ....

   ....[2]

[Turn over

10 Mr Soh is considering to buy a car from one of the three models below.

Car Model	Engine capacity (EC)	Fuel consumption rate
Weisser Sunny	1500 CC	5.3 litre per 100 km
Modela Cooper	1600 CC	0.07 litre per km
MW Racer	2000 CC	12 km per litre

(a) Determine which car's fuel consumption rate is the lowest.

Answer

....

....[2]

(b) Mr Soh decides to buy Modela Cooper.
The information given below shows the costs incurred to maintain his car.

| Type of expense	Rate
Season parking (Residence)	$110 per month
Season parking (Workplace)	$75 per month
Parking charges (Miscellaneous)	$36 per month
ERP charges	$4 per day for 23 days a month
Car insurance	$687 for 6 months
Car servicing and repair	$2500 yearly

The table below shows information related to paying Road Tax in Singapore.

Engine Capacity (EC)	Road Tax Formula for 12 months
EC ≤ 500CC	400×0.782
1000CC< EC ≤ 1600CC	$[500 + 0.75 (EC - 1000)] \times 0.782$
1600CC< EC ≤ 3000CC	$[950 + 1.5 (EC - 1600)] \times 0.782$

Mr Soh drives 450 km per month on the average.

The graph below shows the average monthly fuel price per litre from June 2021 to May 2022.

Average monthly fuel prices per litre
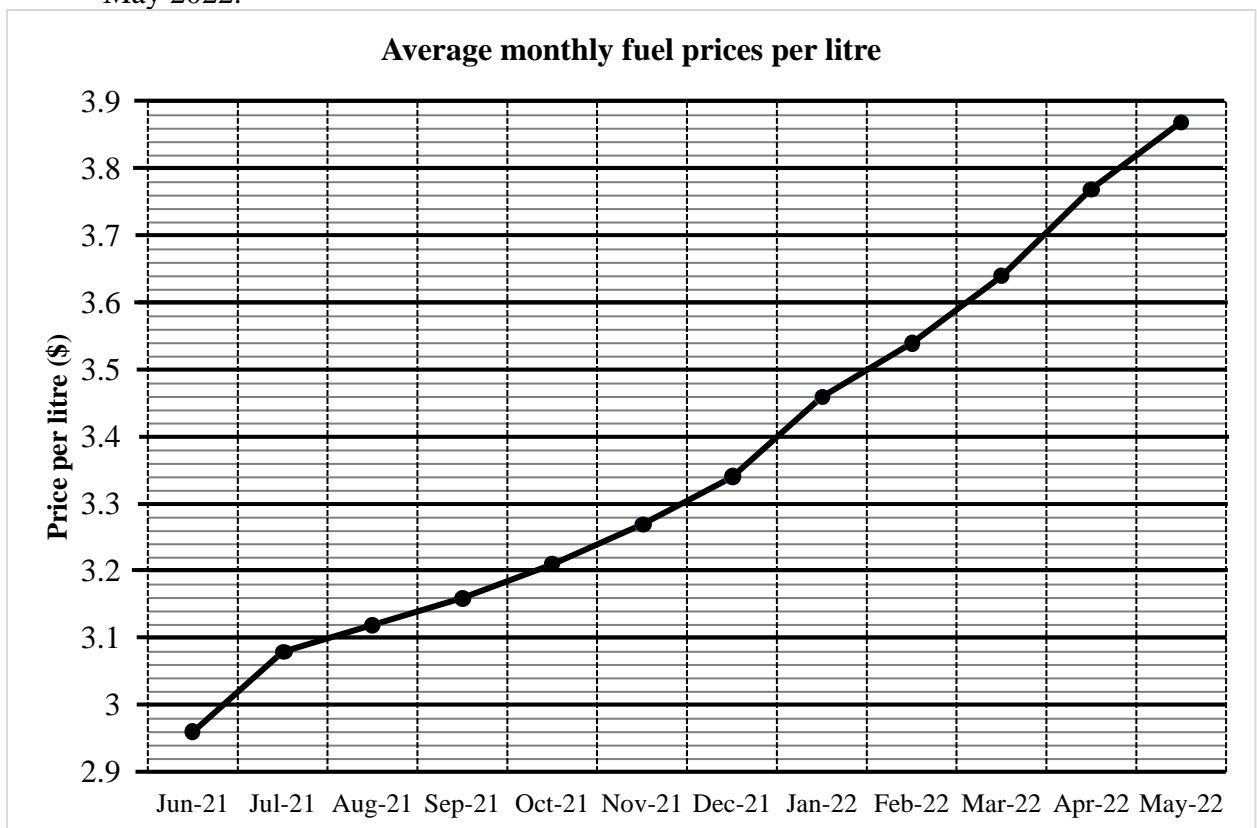
(i) Using the information given, calculate the total amount of money Mr Soh has to put aside for all his car expenses from June 2021 to May 2022.

Answer $……………………………. [7]

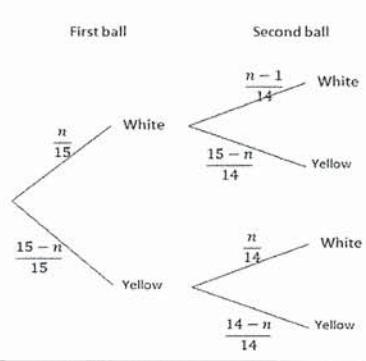**(ii)** State one assumption you made in your calculations for part **(b)(i).**

Answer …………………………………….………………………………………………

………………………………………….…………………………………………………...…

………………………………………….…………………………………………………...…

………………………………………….…………………………………………...….[1]

END OF PAPER

TKSS 2022 Secondary 4 Mathematics Prelim Paper 2 Answers

No.	Answer
1a	$y < 26.5$
1b	$x = -2$, $y = 5$
1c	$\dfrac{-x^2 - x + 8}{(x-2)^2}$
1d	$\dfrac{4a^5bc^2}{3}$
1e	$\dfrac{y-2}{3(y+5)}$
2a	$\begin{pmatrix} 250 & 280 & 260 \\ 320 & 300 & 290 \end{pmatrix}$
2bi	$\begin{pmatrix} 790 \\ 910 \end{pmatrix}$
2bii	It represents the total number of burgers sold on average in Outlet A and B respectively on a weekday.
2ci	$\begin{pmatrix} 1.2 \\ 1.15 \\ 1.3 \end{pmatrix}$
2cii	$\begin{pmatrix} 960 \\ 1106 \end{pmatrix}$
2ciii	$\begin{pmatrix} 5870 \\ 6762 \end{pmatrix}$
2d	\$44212
3a	$y = -7$
3b	Graph
3c	$x = 0.9$ and 3.7
3d	$k = 0.368$
3e	There will be no solutions for p if p is greater than the maximum value of the graph (i.e. $p > 5.9$)
3f	$A = -23$, $B = 10$
4ai	135 m
4aii	170 m
4b	331.1°
4c	42.9 m

No.	Answer
5a	Shown
5b	2.46 cm²
5c	54.5 cm³
6a	$\angle BGA = 2(31)$ $= 2\angle BDF$ ($\angle$ at centre $= 2\angle$ at circumference) Hence, G is the centre of the circle.
6b	$GF = GC = GB = GD\ (radius)$ $\angle BGC = \angle DGF\ (vertically\ opposite\ angles)$ $\Delta BGC\ (or\ \Delta CGB)\ and\ \Delta DGF\ are\ congruent\ (SAS)$
6c	$r = 4.42\text{cm}$
6di	$\angle EBD = 34°$ (angles in the same segment)
6dii	124°
7ai	$\overrightarrow{QT} = 3a + b$
7aii	$\overrightarrow{QP} = 3a + 2b$
7aiii	$\overrightarrow{VU} = -\dfrac{1}{2}(a+b)$
7b	$\overrightarrow{PV} = -\dfrac{3}{2}(a+b)$ $= 3\overrightarrow{VU}$ Since $\overrightarrow{PV} = 3\overrightarrow{VU}$, and V is a common point, P, V and U are collinear.
7ci	$\dfrac{1}{3}$
7cii	$\dfrac{1}{8}$
8a	

No.	Answer
8b	Shown
8ci	$n = 11$ or 18
8cii	Because $n \leq 15$, so $n = 18$ is rejected.
8d	$\dfrac{44}{105}$
9a	Median = 72 Interquartile range = 11
9b	1. May performed better as the mean (or median) of her marks is higher. May is more consistent in her marks as her standard deviation is lower (or interquartile range is smaller)
9c	$x > 59$ He should get 60 marks.
9d	1. Mean will decrease by 2 marks. Standard deviation will be the same.
10a	Modela Cooper : 7 litres per 100 km MW Racer : 8.33 litre per 100 km Or Weisser Sunny : 18.8679 km per litre Modela Cooper: 14.2857km per litre MW Racer: 12 km per litre

No.	Answer
	Weisser Sunny is the most fuel efficient as it uses the least fuel per 100km.
10b	Road Tax yearly = [500 + 0.75(600)] × 0.782 = \$742.90 Petrol needed monthly = 450 × 0.07 = 31.5 litres Sum of fuel prices in a year = 2.96 + 3.08 + 3.12 + 3.16 + 3.21 + 3.27 + 3.34 + 3.46 + 3.54 + 3.64 + 3.77 + 3.87 = \$40.42 Petrol expense yearly = 31.5 × 40.42 =\$1273.231 Parking (total yearly) = (110 + 75 + 36) × 12 = 221 × 12 = \$2652 ERP (yearly) = 4 × 23 × 12 = \$1104 Car insurance = 687 × 2 = \$1374 Total cost yearly = 742.90 + 1273.231 + 2652 +1104 + 1374 + 2500 = \$9646.13
10c	1. He buys season parking monthly at his workplace or home for 12 months. 2. The distance travelled per month is consistent. Fuel consumption rate of his car remain constant.